Using cardiovascular measures for adaptive automation

Stuiver, Arjan


Mulder
workload
Psychol
Biol
mental
heart
rate
task
measures
simulated
performance
Ergonomics
L.J.M
Waard
Backs
Wilson
Brookhuis
Dijksterhuis
Gaillard
Veltman
Erlbaum
Boucsein
Eds
Lawrence
respiration
cardiovascular
indices
Engineering
psychophysiological
psychophysiology
Assessment
Oxford
methods
flight
fatigue
difficulty
analysis
changes
pilot
G.F
R.W
Aviat
effort
issues
Psychophysiology
subjective
road
drivers
Physiological
cardiac
working
physiology
adaptive
Poper
Int
pp
eye
activity
use
New
York
system
state
Applications
Associates
Lawrence
K.A
J.A
A.T

REFERENCES

Aasman, J., Mulder, G., Mulder, & L.J.M. (1987). Operator effort and the measurement of heart-rate variability. *Human Factors: The Journal of the Human Factors and Ergonomics Society 29*, 161-170.

Akselrod, S., Gordon, D., Madwed, J. B., Snidman, N. C., Shannon, D. C., & Cohen, R. J. (1985). Hemodynamic regulation: investigation by spectral analysis. *American Journal of Physiology-Heart and Circulatory Physiology, 249*(4), 867-875.

Althaus, M., Mulder, L.J.M., Mulder, G., Van Roon, A.M., & Minderaa, R.B. (1998). Influence of respiratory activity on the cardiac response pattern to mental effort. *Psychophysiology 35*, 420-430.

Althaus, M., Van Roon, A., Mulder, L.J.M., Mulder, G., Aarnoudse, C.C., & Minderaa, R.B. (2004). Autonomic response patterns observed during the performance of an attention-demanding task in two groups of children with autistic-type difficulties in social adjustment. *Psychophysiology 41*, 893-904.

Backs, R.W. (1998). A comparison of factor analytic methods of obtaining cardiovascular autonomic components for the assessment of mental workload. *Ergonomics 41*, 733-745.

Backs, R.W. (2001). An autonomic space approach to the psychophysiological assessment of mental workload. In Hancock, P.A. & Desmond, P.A. (Eds.), *Stress, Workload and Fatigue* (pp. 279-289). Mahweh, NJ: Erlbaum.

Backs, R.W., & Boucsein, W. (2000). *Engineering psychophysiology as a discipline: historical and theoretical aspects*. Mahwah, NJ: Erlbaum.

Backs, R. W., Ryan, A. M., & Wilson, G. F. (1994). Psychophysiological measures of workload during continuous manual performance. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 36*(3), 514-531.

Backs, R.W., & Seljos, K.A. (1994). Metabolic and cardiorespiratory measures of mental effort: the effects of level of difficulty in a working memory task. *Int. J. Psychophysiol. 16*, 57-68.

Berntson, G. G., Bigger, J. T., & Eckberg, D. L. (1997). Heart rate variability: origins, methods, and interpretive caveats. *Psychophysiol., 34*, 623–648.

Berntson, G.G., Cacioppo, J.T., & Quigley, K.S. (1991). Autonomic determinism: The modes of autonomic control, the doctrine of autonomic space, and the laws of autonomic constraint. *Psychol. Rev. 98*, 459-487.

Berntson, G.G., Cacioppo, J.T., Quigley, K.S., & Farbo, V.T. (1994). Autonomic space and psychophysiological response. *Psychophysiol. 31*, 44-61.

Billings, C.E. (1997). *Aviation automation: The search for a human-centered approach*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Biometric tech assists and IDs drivers, *Biometric Technology Today*, *10*, 3-12. doi:10.1016/S0969-4765(12)70198-4

Blandford, A., & Wong, B.L.W. (2004). Situation awareness in emergency medical dispatch. *International Journal of Human-Computer Studies 61*, 421-452.

Boucsein, W., & Backs, R.W. (2000). Engineering psychophysiology as a discipline: Historical and theoretical aspects. In Backs, R.W. & Boucsein, W. (Eds.), *Engineering psychophysiology: Issues and applications* (pp. 3-30). Mahwah, NJ: Erlbaum.

Broadbent, D.E. (1958). *Perception and communication*. London: Oxford University Press.

Brookhuis, K.A., & de Waard, D. (2010). Monitoring drivers' mental workload in driving simulators using physiological measures. *Accident Analysis & Prevention 42*, 898-903.

Brookhuis, K.A., & de Waard, D. (2001). Assessment of drivers' workload: performance, subjective and physiological indices. In Hancock, P. & Desmond, P., (Eds.), *Stress, workload and fatigue: theory, research and practice* (pp. 321-333). New Jersey: Lawrence Erlbaum.

Brookhuis, K.A., de Waard, D., & Fairclough, S.H. (2003). Criteria for driver impairment. *Ergonomics 46*, 433-445.

Brookhuis, K.A., de Waard, D., & Janssen, W. (2001). Behavioural impacts of advanced driver assistance systems–an overview. *Traffic 1*, 245-253.

Brookings, J.B., Wilson, G.F., & Swain, C.R. (1996). Psychophysiological responses to changes in workload during simulated air traffic control. *Biol. Psychol. 42*, 361-377.

Byrne, E.A., & Parasuraman, R. (1996). Psychophysiology and adaptive automation. *Biol. Psychol. 42*, 249-268.

Cain, B. (2007). *A Review of the Mental Workload Literature*. Defence Research and Development Toronto, Canada.

Coles, M.G.H., & Sirevaag, E. (1987). Heart rate and sinus arrhythmia. In Gale, A. & Christie, B. (Eds.), *Psychophysiology and the electronic workplace (*pp. 255-274). Chichester: John Wiley and Sons Ltd.

De Rivecourt, M., Kuperus, M.N., Post, W.J., & Mulder, L.J.M. (2008). Cardiovascular and eye activity measures as indices for momentary changes in mental effort during simulated flight. *Ergonomics 51*, 1295-1319.

de Waard, D. (1996). *The measurement of drivers' mental workload*. PhD thesis, Traffic Research Centre, University of Groningen, The Netherlands.

de Waard, D., & Brookhuis, K.A. (1991). Assessing driver status: a demonstration experiment on the road. *Accid. Anal. & Prev. 23*, 297-307.

de Waard, D., Jessurun, M., Steyvers, F.J., Raggatt, P.T., & Brookhuis, K.A. (1995). Effect of road layout and road environment on driving performance, drivers' physiology and road appreciation. *Ergonomics 38*, 1395-1407.

de Waard, D., Kruizinga, A., & Brookhuis, K.A. (2008). The consequences of an increase in heavy goods vehicles for passenger car drivers' mental workload and behaviour: A simulator study. *Accid. Anal. & Prev. 40*, 818-828.

de Waard, D., van der Hulst, M., Hoedemaeker, M., & Brookhuis, K.A. (1999). Driver behavior in an emergency situation in the Automated Highway System. *Transp. Hum. Factors 1*, 67-82.

Dijksterhuis, C., Brookhuis, K.A., & de Waard, D. (2011). Effects of steering demand on lane keeping behaviour, self-reports, and physiology. A simulator study. *Acc. Anal. & Prev. 43*(3), *1074-1081*.

Duric, Z., Gray, W.D., Heishman, R., Li, F., Rosenfeld, A., Schoelles, M.J., Schunn, C., & Wechsler, H. (2002). Integrating perceptual and cognitive modeling for adaptive and intelligent human-computer interaction. *Proc IEEE 90*, 1272-1289.

Endsley, M.R., & Kiris, E.O. (1995). The out-of-the-loop performance problem and level of control in automation. *Human Factors: The Journal of the Human Factors and Ergonomics Society 37*, 381-394.

Fairclough, S.H., & Venables, L. (2006). Prediction of subjective states from psychophysiology: a multivariate approach. *Biol. Psychol. 71*, 100-110.

Flemisch, F., Kelsch, J., Löper, C., Schieben, A., & Schindler, J. (2008). Automation spectrum, inner/outer compatibility and other potentially useful human factors concepts for assistance and automation. *Human Factors for assistance and automation*, 1-16.

Freeman, F.G., Mikulka, P.J., Scerbo, M.W., & Scott, L. (2004). An evaluation of an adaptive automation system using a cognitive vigilance task. *Biol. Psychol. 67*, 283-297.

Gaillard, A.W.K., & Kramer, A.F. (2000). Theoretical and methodological issues in psychophysiological research. In Backs, R.W. & Boucsein, W. (Eds.), *Engineering psychophysiology: Issues and applications* (pp. 31-58). Mahwah, NJ: Erlbaum.

Gendolla , G.H.E., & Krüsken, J. (2001). The joint impact of mood state and task difficultyon cardiovascular and electrodermal reactivity in active coping. *Psychophysiology 38*, 548–556.

Grossman, P., & Taylor, E.W. (2007). Toward understanding respiratory sinus arrhythmia: relations to cardiac vagal tone, evolution and biobehavioral functions. *Biol. Psychol. 74*, 263-285.

Haarmann, A., Boucsein, W., & Schaefer, F. (2009). Combining electrodermal responses and cardiovascular measures for probing adaptive automation during simulated flight. *Appl. Ergon. 40*, 1026-1040.

Haas, M., & Hettinger, L. (2001). Current Research in Adaptive Interfaces. *International Journal of Aviation Psychology 11*, 119-121.

Hancock, P.A., & Parasuraman, R. (1992). Human factors and safety in the design of intelligent vehicle-highway systems (IVHS). *J. Saf. Res. 23*, 181-198.

Hankins, T.C., & Wilson, G.F. (1998). A comparison of heart rate, eye activity, EEG and subjective measures of pilot mental workload during flight. *Aviat. Space Environ. Med. 69*, 360-367.

Healey, J.A. (2009). Affect detection in the real world: Recording and processing physiological signals. In Proceedings of the IEEE 3rd International Conference on Affective Computing and Intelligent Interaction, ACII 1, 1-6. Amsterdam, The Netherlands: IEEE Press.

Hockey, G.R.J. (1997). Compensatory control in the regulation of human performance under stress and high workload; a cognitive-energetical framework. *Biol. Psychol. 45*, 73-93.

Hockey, G.R.J., Gaillard, A.W.K. & Burov, O. (2003). *Operator Functional State. The assessment and prediction of human performance degradation in complex tasks*. Amsterdam: IOS Press.

Hoogeboom, P.J., & Mulder, L.J.M. (2004). Physiological indices for the estimation of momentary changes in cognitive workload and mental state. In De Waard, D., Brookhuis, K.A. & Weikert, C. (Eds.), *Human Factors in Design (*pp. 147-160). Maastricht: Shaker Publishing.

Hoover, A., Singh, A., Fishel-Brown, S. & Muth, E.(2011). Real-time detection of workload changes using heart rate variability. *Biomedical Signal Processing and Control* 7(4), 333-341.

Jordan, D. (1990). Autonomic changes in affective behaviour. In Loewy, E.D. & Spyer, K.M. (Eds.), *Central regulation of autonomic function (*pp. 349-366). New York: Oxford University Press.

Jorna, P.G. (1992). Spectral analysis of heart rate and psychological state: a review of its validity as a workload index. *Biol. Psychol. 34*, 237-257.

Julius, S. (1988). The blood pressure seeking properties of the central nervous system. *J. Hypertens. 6*, 177-185.

Kahneman, D. (1973). *Attention and effort*. Englewood Cliffs, NJ: Prentice-Hall Inc.

Klimesch, W. (1996). Memory processes, brain oscillations and EEG synchronization. *International Journal of Psychophysiology 24*, 61-100.

Kramer, A.F. (1991). Physiological metrics of mental workload: a review of recent progress. In Damos, D.L. (Ed.), *Multiple-task Performance* (pp. 279-328). London: Taylor & Francis.

Laumann, K., Gärling, T., & Stormark, K. M. (2003). Selective attention and heart rate responses to natural and urban environments. *Journal of environmental psychology, 23*(2), 125-134.

Meister, D. (1976). *Behavioral foundations of system development*. New York: Wiley.

Meshkati, N., Hancock, P.A., Rahimi, M., & Dawes, S.M. (1995). Techniques in mental workload assessment. In Wilson, J.R., & Corlett, E.N. (Eds.), *Evaluation of human work: A practical ergonomics methodology (2nd ed.) (*pp. 749-782). Philadelphia, PA: Taylor & Francis.

Michon, J.A. (1985). A critical view of driver behavior models: what do we know, what should we do?. In Evans, L., & Schwing, R.C. (Eds.), *Human behavior and traffic safety* (pp. 485-520). New York, NY: Plenum.

Mikulka, P.J., Scerbo, M.W., & Freeman, F.G. (2002). Effects of a biocybernetic system on vigilance performance. *Hum. Factors 44*, 654-664.

Miller, C.A., & Parasuraman, R. (2007). Designing for flexible interaction between humans and automation: Delegation interfaces for supervisory control. *Human Factors: The Journal of the Human Factors and Ergonomics Society 49*, 57.

Milosovic, S. (1997). Drivers' fatigue studies. *Ergonomics 40*, 381-389.

Mulder, G. (1980). *The heart of mental effort*. PhD thesis, University of Groningen, The Netherlands.

Mulder, G. (1986). The concept and measurement of mental effort. In Hockey, G.R.J., Gaillard, A.W.K., & Coles, M.G.H. (Eds.), *Energetical Issues in Research on Human Information Processing* (pp. 175-198). Dordrecht, The Netherlands: Martinus Nijhoff.

Mulder, L.J.M. (1992). Measurement and analysis methods of heart rate and respiration for use in applied environments. *Biol. Psychol. 34*, 205-236.

Mulder, G., & Mulder, L.J.M. (1981). Information processing and cardiovascular control. *Psychophysiology 18*, 392-402.

Mulder, L.J.M., & Mulder, G. (1987). Cardiovascular reactivity and mental workload. In Rompelman, O., & Kitney, R.I. (Eds.), *The beat-to-beat investigation of cardiovascular function* (pp. 216-253). Oxford: Oxford University Press.

Mulder, L.J.M., de Waard, D., & Brookhuis, K.A. (2004). Estimating Mental Effort using Heart Rate and Heart Rate Variability. In Stanton, N., Hedge, A., Hendrick, H.W., Brookhuis, K.A., & Salas, E. (Eds.), *Handbook of Ergonomics and Human Factors Methods*. London: Taylor & Francis.

Mulder, B., de Waard, D., Hoogeboom, P., Quispel, L., & Stuiver, A. (2008). Using Physiological Measures for Task Adaptation. In *Probing experience* (pp. 221-234). Netherlands: Springer.

Mulder, L.J.M., Dijksterhuis, C., Stuiver, A., & de Waard, D. (2009). Cardiovascular state changes during performance of a simulated ambulance dispatcher's task: potential use for adaptive support. *Appl. Ergon. 40*, 965-977.

Mulder, G., Mulder, L. J. M., Meijman, T. F., Veldman, J. B. P., & Van Roon, A. M. (2000). A psychophysiological approach to working conditions. In Backs, R.W. & Boucsein, W. (Eds.), *Engineering psychophysiology: Issues and applications* (pp. 139–159). Mahwah, NJ: Erlbaum.

Mulder, L.J.M., Leonova, A.B., & Hockey, G.R.J. (2003). Methods for assessing operator functional state. In Hockey, G.R.J., Gaillard, A.W.K., & Burov, O. (Eds.), *Operator functional state* (pp. 356-362). Amsterdam: IOS Press.

Mulder, L.J.M., Veldman, J.B.P., Veen, F.A., van der Roon, A.M., van Ruddel, H., Schachinger, H., & Mulder, G. (1992). On the effects of mental task performance on heart rate, blood pressure and its variability measures. In Di Rienzo, M., Mancia, G., Parati, G., Pedotti, A., & Zanchetti, A. (Eds.), *Blood Pressure and Heart Rate* (pp. 153-166). Amsterdam: IOSPress.

Myrtek, M., Deutschmann-Janicke, E., Strohmaier, H., Zimmermann, W., Lawerenz, S., Brugner, G., & Muller, W. (1994). Physical, mental, emotional, and subjective workload components in train drivers. *Ergonomics 37*, 1195-1203.

Nickel, P., & Nachreiner, F. (2003). Sensitivity and diagnosticity of the 0.1-Hz component of heart rate variability as an indicator of mental workload. *Human Factors: The Journal of the Human Factors and Ergonomics Society 45*, 575.

Noel, J.B., Bauer Jr., K.W., & Lanning, J.W. (2005). Improving pilot mental workload classification through feature exploitation and combination: a feasibility study. *Comput. Oper. Res. 32*, 2713-2730.

Obrist, P.A., 1981. *Cardiovascular psychophysiology: A perspective*. New York: Plenum Press.

Parasuraman, R., Bahri, R., Deaton, T., Morrison, J., & Barnes, M. (1992). *Theory and design of adaptive automation in aviation systems*. Cognitive Science Lab, Catholic Univ Of America, Washington DC.

Parasuraman, R., & Riley, V. (1997). Humans and automation: Use, misuse, disuse, abuse. *Human Factors: The Journal of the Human Factors and Ergonomics Society 39*, 230-253.

Parasuraman, R., Sheridan, T.B., & Wickens, C.D. (2000). A model for types and levels of human interaction with automation. *Systems, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on 30,* 286-297.

Picard, R.W. (1997). *Affective computing*. Cambridge, Mass.: The MIT press.

Poh, M., McDuff, D., & Picard, R. (2010). Non-contact, automated cardiac pulse measurements using video imaging and blind source separation. *Opt. Express 18*, 10762-10774.

Pope, A.T., Bogart, E.H., & Bartolome, D.S. (1995). Biocybernetic system evaluates indices of operator engagement in automated task. *Biol. Psychol. 40*, 187-195.

Porges, S.W., & Byrne, E.A. (1992). Research methods for measurement of heart rate and respiration. *Biol. Psychol. 34*, 93-130.

Posner, M.I. (1980). Orienting of attention. *Q. J. Exp. Psychol. 32*, 3-25.

Prinzel, L. (2002). *Research on hazardous states of awareness and physiological factors in aerospace operations*. NASA Langley Research Centre, NASA/TM-2002-211444

Prinzel, L.J., Freeman, F.G., Scerbo, M.W., Mikulka, P.J., & Pope, A.T. (2000). A closed-loop system for examining psychophysiological measures for adaptive task allocation. *Int. J. Aviat. Psychol. 10*, 393-410.

Raggatt, P.T., & Morrissey, S.A. (1997). A field study of stress and fatigue in long-distance bus drivers. *Behav. Med. 23*, 122-129.

Rasmussen, J. (1987). *The definition of human error and a taxonomy for technical system design*. New York, NY: John Wiley and Sons.

Reyes del Paso, G.A., Gonzalez, I., & Hernandez, J.A. (2004). Baroreceptor sensitivity and effectiveness varies differentially as a function of cognitive-attentional demands. *Biol. Psychol. 67*, 385-395.

Robbe, H.W., Mulder, L.J.M., Ruddel, H., Langewitz, W.A., Veldman, J.B., & Mulder, G. (1987). Assessment of baroreceptor reflex sensitivity by means of spectral analysis. *Hypertension 10*, 538-543.

Rompelman, O. (1985). Spectral analysis of heart-rate variability. In Orlebeke, J. F., Mulder, G., & van Doornen, L. P. J. (Eds.), *Psychophysiology of Cardiovascular Control* (pp. 315-331).

Roscoe, A.H. (1992). Assessing pilot workload. Why measure heart rate, HRV and respiration?. *Biol. Psychol. 34*, 259-287.

Rouse, W.B. (1988). Adaptive aiding for human/computer control. *Human Factors: The Journal of the Human Factors and Ergonomics Society 30*, 431-443.

Salmon, P.M., Lenne, M.G., Stanton, N.A., Jenkins, D.P., & Walker, G.H. (2010). Managing error on the open road: The contribution of human error models and methods. *Saf. Sci. 48*, 1225-1235.

Scerbo, M.W. (1996). Theoretical perspectives on adaptive automation. In Parasuraman, R., & Mouloua, M. (Eds.), *Automation and human performance: Theory and applications. Human factors in transportation* (pp. 37-63). Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc.

Scerbo, M.W. (2001). Stress, workload, and boredom in vigilance: A problem and an answer. In Hancock, P.A., & Desmond, P.A. (Eds.), *Stress, workload, and fatigue* (pp. 267-278). Mahwah, NJ: Lawrence Erlbaum Associates.

Schalk, G., McFarland, D. J., Hinterberger, T., Birbaumer, N., & Wolpaw, J. R. (2004). BCI2000: a general-purpose brain-computer interface (BCI) system. *Biomedical Engineering, IEEE Transactions on, 51*(6), 1034-1043.

Schier, M.A. (2000). Changes in EEG alpha power during simulated driving: a demonstration. *International Journal of Psychophysiology 37*, 155-162.

Sheridan, T., & Verplank, W. (1978). *Human and computer control of undersea teleoperators*. Man-Machine Systems Lab, Massachusetts Inst Of Tech, Cambridge.

Sirevaag, E.J., Kramer, A.F., Reisweber, C.D.W.M., Strayer, D.L., & Grenell, J.F. (1993). Assessment of pilot performance and mental workload in rotary wing aircraft. *Ergonomics 36*, 1121-1140.

Spear, J.F., Kronhaus, K.D., Moore, E.N., & Kline, R.P. (1979). The effect of brief vagal stimulation on the isolated rabbit sinus node. *Circ. Res. 44*, 75-88.

Spiessl, W., & Hussmann, H. (2011). Assessing error recognition in automated driving (Selected papers from the 2nd European Conference on Human Centred Design in ITS). *IET intelligent transport systems 5*, 103-111.

Stanton, N., & Young, M. (1998). Vehicle automation and driving performance. *Ergonomics 41*, 1014-1028.

Stuiver, A., de Waard, W., Brookhuis, K.A., Dijksterhuis, C., Lewis-Evans, B., & Mulder, L.J.M. (2012). Short-Term Cardiovascular Responses to Changing Task Demands. *International Journal of Psychophysiology 85*(2), 153-160.

Stuiver, A., & Mulder, L.J.M. (2009). Artefact-free Real-time Computation of Cardiovascular Measures. In Proceedings of the IEEE 3rd International Conference on Affective Computing and Intelligent Interaction, ACII 1, 716-721. Amsterdam, The Netherlands: IEEE Press.

Thayer, R. E. (1989). *The biopsychology of mood and arousal*. Oxford: Oxford University Press.

Ting, C.H., Mahfouf, M., Nassef, A., Linkens, D.A., Panoutsos, G., Nickel, P., Roberts, A.C., & Hockey, G.R.J. (2010). Real-Time Adaptive Automation System Based on Identification of Operator Functional State in Simulated Process Control Operations. *IEEE Transactions on Systems, Man, and Cybernetics, Part A 40*, 251-262.

van der Hulst, M. (1999) . *Adaptive control on safety margins in driving*. PhD thesis, University of Groningen, Groningen, The Netherlands.

van der Veen, F.M., Mulder, L.J., Hoekzema, A., & Mulder, G. (1996). Covariation of phasic cortical and cardiovascular responses in a detection task. *Biol. Psychol. 44*, 105-120.

van Roon, A.M. (1998). *Short-term cardiovascular effects of mental tasks, physiology, experiments and computer simulations.* PhD thesis, University of Groningen, Groningen, The Netherlands.

van Roon, A.M., Mulder, L.J.M., Althaus, M., & Mulder, G. (2004). Introducing a baroreflex model for studying cardiovascular effects of mental workload. *Psychophysiology 41*, 961-981.

van Winsum, W., & van Wolffelaar, P.C. (1993). GIDS Small World simulation. In Michon, J.A. (Ed.), *Generic Intelligent Driver Support* (pp. 175-191). London: Taylor & Francis.

Veldman, J.B.P., Mulder, L.J.M., van Roon, A.M., van Der Veen, F.M., & Mulder, G. (1998). Test measurements are a powerful tool in determining cardiovascular effects of long lasting mental work. *Journal of Psychophysiology 12*, 338-352.

Veltman, J.A., & Gaillard, A.W.K (1996). Physiological indices of workload in a simulated flight task. *Biol. Psychol. 42*, 323-342.

Veltman, J.A., & Gaillard, A.W. (1998). Physiological workload reactions to increasing levels of task difficulty. *Ergonomics 41*, 656-669.

Vicente, K.J., Thornton, C.D., & Moray, N. (1987). Spectral analysis of sinus arrhythmia: a measure of mental effort. *Human Factors: The Journal of the Human Factors and Ergonomics Society 29*, 171-182.

Whang, M. C., Lim, J. S., & Boucsein, W. (2003). Preparing computers for affective communication: A psychophysiological concept and preliminary results. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 45*(4), 623-634.

Weber, E.J., Molenaar, P.C., & van der Molen, M.W. (1992). A nonstationarity test for the spectral analysis of physiological time series with an application to respiratory sinus arrhythmia. *Psychophysiology 29*, 55-65.

Wesseling, K.H., & Settels, J.J. (1985). Baromodulation explains short-term blood pressure variability. In Orlebeke, J.F., Mulder, G., & van Doornen, L.P.J. (Eds.), *The psychophysiology of cardiovascular control* (pp. 69-97). New York: Plenum Press.

Wickens, C.D. (1984). Processing resources in attention. In Parasuraman, R., & Davies, D.R. (Eds.), *Varieties of attention* (pp. 63-102). Orlando, FL: Academic Press.

Wiener, E.L. (1989). *Human factors of advanced technology ("glass cockpit"). transport aircraft.* SuDoc NAS 1.26:177528.

Wiener, E.L., & Curry, R.E. (1980). Flight-deck automation: Promises and problems. *Ergonomics 23*, 995-1012.

Wientjes, C.J. (1992). Respiration in psychophysiology: methods and applications. *Biol. Psychol. 34*, 179-203.

Wieringa, F.P., Mastik, F., & van der Steen, A.F. (2005). Contactless multiple wavelength photoplethysmographic imaging: a first step toward "SpO2 camera" technology. *Ann. Biomed. Eng.* 33(8), 1034–1041.

Wilson, G.F. (1992). Applied use of cardiac and respiration measures: practical considerations and precautions. *Biol. Psychol. 34*, 163-178.

Wilson, G.F. (1993). Air-to-ground training missions: a psychophysiological workload analysis. *Ergonomics 36*, 1071-1087.

Wilson, G.F., & Russell, C.A. (2003). Real-time assessment of mental workload using psychophysiological measures and artificial neural networks. *Human Factors: The Journal of the Human Factors and Ergonomics Society 45*, 635.

Young, M.S., Birrell, S.A., & Stanton, N.A. (2009). Design for smart driving: A tale of two interfaces. In Harris, D. (Eds.), *Engineering Psychology and Cognitive Ergonomics* (pp. 477-485). Berlin / Heidelberg: Springer.

Yubin, Q., Shuming, P., Haoxue, L., & Changshui, W. (2010). Design of Test System on Nighttime Driving Behavior and ECG Characteristics of Long-distance Bus Drivers (II) Experimental Result Analysis. *WASE International Conference on Information Engineering (ICIE), 3*, 465-468.

Zijlstra, F.R.H. (1993). *Efficiency in work behavior*. PhD thesis, Technical University Delft, Delft, The Netherlands.